

**ONCOZYGIA CLAVICORNIS STÅL AND ALLOPODOPS MISSISSIPPIENSIS
HARRIS AND JOHNSTON: ASSOCIATION OF RARELY COLLECTED
NEARCTIC TURTLE BUGS (HETEROPTERA: PENTATOMIDAE:
PODOPINAE) WITH AN INTRODUCED AFRICAN GRASS**

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Abstract.—Adults and nymphs of *Oncozygia clavicornis* Stål were observed in crowns of an African bunchgrass, weeping lovegrass (*Eragrostis curvula* (Schröd.) Nees), at eight sites in Alabama, North Carolina, and South Carolina. Alabama and North Carolina represent new state records, and *E. curvula* is the first host plant associated with this rarely collected turtle bug. Adults overwinter, and two generations apparently are produced on this host. Plant architecture, particularly the dense crowns and vegetative litter that accumulates in crowns of older plants, as well as the loose sandy soils, might have facilitated the colonization of weeping lovegrass by *O. clavicornis*. An adult of another rarely collected turtle bug, *Allopodops mississippiensis* Harris and Johnston, was collected on weeping lovegrass at each of three localities in South Carolina.

Key Words: Insecta, pentatomids, weeping lovegrass, sandhills, host shifts, biodiversity conservation

The pentatomid subfamily Podopinae, containing about 255 species in 64 genera, is distributed nearly worldwide, but attains its greatest diversity in the Ethiopian Region (Barber and Sailer 1953, Schuh and Slater 1995). This group's taxonomic history and relationships within the Pentatomidae and with other Pentatomoidea have been problematic. Two tribes, the Graphosomatini and the Podopini, have been recognized (Schaefer 1981, 1983), but Davidová-Vilímová and Štys (1994) proposed five tribes: Deroploini, Brachycerocerini, and Tarisini in addition to the two previously recognized. A diagnosis of the Podopinae is provided by Rolston and McDonald (1979) and Schuh and Slater (1995). The North American fauna consists of 13 species in six genera, all belonging to the nominate tribe (Froeschner 1988). Sev-

eral Nearctic genera and species have been described from only one or two specimens (Slater and Baranowski 1970).

Biological information on the Podopinae, often referred to as turtle bugs, is scant. Graphosomatines are associated with dicotyledonous families such as the Apiaceae, Brassicaceae, Chenopodiaceae, and Ranunculaceae, as well as monocots such as grasses. Several Old World species feed on seeds of their hosts. The drably colored Podopini feed mainly on stems of grasses, sedges, or rushes in damp habitats, although few host records are available to discern feeding habits and trends in this tribe (Schaefer 1981, 1983). With the exception of *Amaurochrous cinctipes* (Say) (McPherson and Paskewitz 1984), the habits of North American podopines are largely unknown. Here, I record the colonization of

an introduced African plant, weeping lovegrass (*Eragrostis curvula* (Schrad.) Nees), by *Oncozygia clavicornis* Stål, giving Alabama and North Carolina as new state records. Also reported are three South Carolina collections of another rarely collected Nearctic turtle bug, *Allopodops mississippiensis* Harris and Johnston, from the same plant species.

Oncozygia clavicornis, belonging to a monotypic genus, was described from a specimen from "America borealis, Texas" (Stål 1872); it also has been reported from Florida, Mississippi, Virginia, and South Carolina (Froeschner 1988). A Canadian record (Vancouver, B.C.) probably represents a misidentification (Barber and Sailer 1953, Froeschner 1988). Torre-Bueno (1920) and Blatchley (1926) remarked that this species is rare or very rare whenever found, and most records previous to my study are based on single specimens. Barber and Sailer (1953) in revising the Podopinae (as tribe Podopini of the Graphosomatinae) examined material from seven localities, with the number of specimens not stated, but likely to have been only seven. The National Museum of Natural History, Smithsonian Institution (USNM) has since acquired two additional specimens, one each from Sanford, Fla., and from Folly Beach, S.C. Additional material consists of a specimen from Hurley, Miss. (Mississippi Entomological Museum); two from College Station, Tex. (David A. Rider Collection); and three from Texas (one each from College Station, Lange's Mill [Gillespie Co.], and Minter Springs) and one from Biloxi, Miss. (Texas A&M University Collection). The last-named specimen might be the one Barber and Sailer (1953) mentioned from the Mississippi Agricultural Experiment Station Collection, but which is not now in the Mississippi Entomological Museum (T. L. Schiefer, personal communication). Published bionomical information is limited to the capture of a specimen on a screen trap in a Texas cotton field (Gaines 1933).

Allopodops mississippiensis also belongs

to a monotypic genus. Since the description by Harris and Johnston (1936) of a female from Wiggins, Miss., it has been recorded only from two additional localities: Jocassee, S.C., and Falls Church, Va.; both records also are based on single specimens (Barber and Sailer 1953). Three specimens have been added to the USNM since Barber and Sailer's (1953) revision: two from Myrtle Beach, S.C., and one from Santee, S.C. The Falls Church, Va., specimen was collected on a sedge (Cyperaceae) (Hoffman 1971).

HOST PLANT AND METHODS

New records of *O. clavicornis* and information on its seasonal history were obtained from 1996 to 1999 during a study of the insect fauna associated with crowns of weeping lovegrass. *Eragrostis curvula sensu lato* is highly polymorphic, its germplasm comprising diverse forms of uncertain taxonomic status. This grass, therefore, is sometimes referred to as the *E. curvula* complex (Gibbs Russell et al. 1991, Burson and Voigt 1996, Poverene and Voigt 1997). Weeping lovegrass, a perennial bunchgrass native to central and southern Africa, is characterized by rapid growth and a dense root system and crown (Crider 1945). It is used for conservation and forage in many (mainly semiarid) regions of the world (Cox et al. 1988, Phillips et al. 1991, Burson and Voigt 1996, Poverene and Voigt 1997). First planted in the United States in Arizona and Oklahoma during the mid-1930s (Crider 1945, Gamble 1970), weeping lovegrass is used along road banks in the southeastern states to reduce erosion (e.g., Richardson and Diseker 1965). It is also used to revegetate mine spoils (Cumings 1947, Tyner et al. 1948, Vogel 1970) and is sometimes planted as an ornamental (Bailey and Bailey 1976, Greenlee 1992). Although *E. curvula* is considered a weed in New South Wales, Australia (Scott and Delfosse 1992), it is not considered invasive in the southern United States (Vogel 1970). The plant, however, is now natural-

ized in Florida and in the southwestern states (Bailey and Bailey 1976).

Southeastern U.S. plantings are of relatively recent origin, the oldest probably dating from the early 1940s. In 1942, the U.S. War Department took over part of the National Wildlife Refuge, McBee, S.C., planting weeping lovegrass in an X pattern in an area cleared as a bombing range (R.P. Ingram, pers. comm.). Most of the plantings, however, have originated since the 1950s or 1960s. Weeping lovegrass was first reported from South Carolina by Radford and Ahles (1959) and from North Carolina by Ahles and Radford (1959), who noted the plant is becoming increasingly abundant in South Carolina. *Eragrostis curvula* was found in only one of 14 counties (Lexington Co., S.C.) during studies of plants in xeric sands of the Fall-line Sandhills (Duke 1961). Weeping lovegrass now occurs in xeric sandhills of all 14 counties that Duke (1961) surveyed in Georgia, North Carolina, and South Carolina in the late 1950s (AGW, personal observation).

Following the discovery of *O. clavicornis* on weeping lovegrass at Fayetteville, N.C., in 1996, I surveyed for the turtle bug in 160 additional plantings of *E. curvula*, mainly along roads in the Fall-line Sandhills (e.g., Duke 1961, Stout and Marion 1993) from North Carolina to Alabama. An axe handle was used to beat the crowns of weeping lovegrass over a white enamel pan. Dislodged adults and nymphs of *O. clavicornis* were recorded, with nymphs mainly identified to stage in the field; representative specimens of adults and nymphs were collected. Adults have been deposited in the USNM.

At irregular intervals, the total numbers of *O. clavicornis* observed were recorded at Fayetteville, N.C., and at three other sites in North Carolina (near Marston) and South Carolina (Middendorf and near McBee); on some of the visits, I also recorded the numbers of plants that yielded adults or nymphs. I made at least one attempt to re-collect *O. clavicornis* at those four sites and

at two others where it was found—near Pee Dee, S.C., and at Seale, Ala.—to try to verify the establishment of populations on weeping lovegrass. The site in Harnett County, North Carolina, was visited only once, whereas in Richland County, South Carolina, *O. clavicornis* was found only in the fourth season of surveys. Time spent in the field depended on the number of weeping lovegrass plants present, with more time spent sampling at Fayetteville and Middendorf than at the other four sites.

At the North Carolina and South Carolina sites (except nr. Johnsonville, N.C., and nr. Pee Dee, S.C.), I also sampled other grasses, particularly native species, growing within 10 m of weeping lovegrass. The well-developed crowns of bunchgrasses such as broom sedge (*Andropogon virginicus* L.) and wiregrass (*Aristida* spp.) were sampled similarly to those of weeping lovegrass. Grasses with poorly developed crowns that could not be sampled effectively by beating, as well as some *A. virginicus*, were uprooted and the roots shaken over a pan in an attempt to detect podopines.

RESULTS

Oncozygia clavicornis (Fig. 1) was found on weeping lovegrass at eight sites in Alabama, North Carolina, and South Carolina, including Pee Dee, S.C., where the only individual observed was a dead adult. At the other sites (except Harnett Co., N.C., and Richland Co., S.C.), *O. clavicornis* was found during return visits. The numbers of adults and nymphs observed in the field are listed below; the numbers of adults collected and deposited in the USNM are given in parentheses.

ALABAMA: Russell Co., Rt. 431, Seale: 9 Apr. 1997, 2 adults (2); 9 May 1998, 2 adults (1).

NORTH CAROLINA: Cumberland Co., Rt. 401, Fayetteville: 10 July 1996, 4 adults (4), 11 nymphs; 25 Aug. 1996, 17 adults (17), 3 nymphs, 30 of ca. 60 plants positive for *O. clavicornis*; 20 Sept. 1996, 15 adults (2), 2 nymphs, 9 of 20 plants positive; 8



Fig. 1. *Oncozygia clavicornis* on stems of weeping lovegrass, *Eragrostis curvula*.

Mar. 1997, 4 adults, 3 of 30 plants positive; 30 Mar. 1997, 22 adults, 7 of 20 plants positive; 30 Apr. 1997, ca. 40 adults (2), 1 nymph; 12 July 1998, 17 adults (3), 50 nymphs, 16 of 30 plants positive; 6 Sept. 1998, 71 adults (2), 22 nymphs; 5 Dec. 1998, 5 adults (2), 4 of ca. 30 plants positive.

NORTH CAROLINA: Harnett Co., Rts. 24–27, 0.8 km W. of Johnsonville: 31 Oct. 1998, 4 adults (2).

NORTH CAROLINA: Richmond Co., Rt. 1, 2.4 km N. of Marston: 25 Aug. 1996, 9 adults (9), 5 nymphs, 2 of ca. 25 plants positive; 29 Mar. 1997, 1 adult; 12 July 1998, 0 of 25 plants positive.

SOUTH CAROLINA: Chesterfield Co., Rt. 1, 3.9 km N. of McBee: 28 Aug. 1996, 5 adults (5), 2 nymphs, 5 of ca. 20 plants positive; 20 Sept. 1996, 3 adults; 11 July 1998, 1 adult, 1 of 12 plants positive.

SOUTH CAROLINA: Chesterfield Co., Rt. 1, Middendorf: 28 Aug. 1996, 2 adults (2), 1 nymph, 2 of 40 plants positive; 29

Mar. 1997, 3 adults; 15 May 1998, 3 adults (1); 4 June 1998, 2 adults (1); 11 July 1998, 1 adult, 1 nymph, 2 of 50 plants positive; 6 Sept. 1998, 2 adults (1); 5 Dec. 1998, 1 adult, 1 of ca. 40 plants positive.

SOUTH CAROLINA: Marion Co., Rt. 301, 1.8 km N. of Pee Dee: 14 Sept. 1996, 1 adult, dead when found (1); 11 July 1998, 0 of ca. 40 plants positive.

SOUTH CAROLINA: Richland Co., Spears Creek Church Rd., 3.8 km S. of Pontiac, 22 May 1999, 2 adults (2).

In addition to the above records from weeping lovegrass, an adult was beaten from the crown of bushy bluestem (*Andropogon glomeratus* (Walter Britton et al.) in Florida: Polk Co., Rt. 27, 3 km N. of Lake Wales, 17 Mar. 1999.

Allopodops mississippiensis.—Three adults (deposited in USNM) were encountered during surveys of lovegrass in South Carolina. The sites in Pickens County are in the Piedmont rather than Fall-line Sandhills.

SOUTH CAROLINA: Chesterfield Co., Rt. 1, Middendorf, 11 July 1998, 1 adult; Pickens Co., S. of Brookbend Rd. nr. Todds Creek, 3 km S. of Six Mile, 25 Apr. 1997, 1 adult; Glassy Mountain Heritage Preserve, E. of Pickens, 17 Oct. 1998, 1 adult.

DISCUSSION

Native phytophagous insects can rapidly colonize (<100 years) introduced plant species, the new interactions sometimes resulting in partial or complete specialization on the new hosts (Strong et al. 1984, Wheeler and Mengel 1984, Thompson 1994). Since the 1940s, and undoubtedly more recently in some cases, the New World podopine *O. clavicornis* has colonized an African grass, *E. curvula*, in sandhills of the southeastern United States. It is one of the few Nearctic podopines that have been found in dry habitats, most species having been collected in or near marshes, ponds, sloughs, and streams (e.g., Blatchley 1926, Barber and Sailer 1953, Schaefer 1981). *Oncozygia clavicornis* is also known from the Upper Coastal Plain (Pee Dee, S.C.) and Coastal Zone (USNM collection), where it might occur in moister habitats than it does in xeric sandhills. The habitat in which it was found on bushy bluestem in Florida is seasonally wet.

The native host plants of *O. clavicornis* remain unknown; I did not find it on other grasses at sites where it occurred on weeping lovegrass. *Oncozygia clavicornis* might be more difficult to collect on its native hosts than on *E. curvula*, a bunchgrass with a well-developed crown from which podopines can be easily dislodged. The only evidence for a native host association is the collection of an adult on *Aristida* sp. (Poaceae) at Folly Beach, S.C., in November 1944 (USNM collection) and an adult on *Andropogon glomeratus* in Florida (see Results).

More than 125 years after the original description of *O. clavicornis* only about 15–20 specimens have been available in institutional collections. The scarcity of material

in collections probably reflects this bug's cryptic or secretive habits, like those of other podopines (Slater and Baranowski 1970, Hoffman 1971), rather than its actual rarity. Several adults I collected from crowns of weeping lovegrass were encrusted with soil, suggesting that this species sometimes occurs on basal stems near ground level or actually enters the soil. Blatchley (1926) mentioned a grayish crust on a Texas specimen of *O. clavicornis*.

When dislodged from crowns of weeping lovegrass, nymphs and adults often were grasping pieces of host stems. They feigned death when disturbed and always moved slowly, such behavior contrasting with that of most other pentatomids. Although *O. clavicornis* appears capable of flight, adults were not observed to fly.

Plant architecture, perhaps more than secondary plant chemistry or other components of nutritional quality, might be key to this podopine's colonization of *E. curvula*. The dense crowns of weeping lovegrass and thick masses of vegetative material that build up around crowns of undisturbed plants (Crider 1945) offer protection from blowing sand, burning, cold, and drought (Phillips et al. 1991), and perhaps natural enemies. In the case of delphacid planthoppers, grasses that produce a consistent thatch not only provide greater refuge from predators, but also more feeding and oviposition sites than thatchless grass species (Denno 1994). I found *O. clavicornis* only on *E. curvula* growing in loose, sandy soils of the Sandhills and Coastal Plain. The bugs were associated with older (unmowed), large plants with accumulated litter except at Fayetteville, N.C., where they also were found on smaller plants lacking a large crown. The structurally complex *E. curvula*, with its dense crown and litter accumulation, might allow *O. clavicornis* to develop greater densities than it can on native hosts of simpler architecture.

Somewhat analogously, the adventive aquatic plant, water hyacinth (*Eichhornia crassipes* (Mart.) Solms), is characterized in

Florida by a rich invertebrate fauna that includes scarce species difficult to find on native hosts such as water lettuce (*Pistia stratiotes* L.). Water hyacinth's three dimensionality probably facilitated its rapid colonization by a diverse community of invertebrates (O'Hara 1967, Carr 1994).

Exotic or nonindigenous plants often affect native biodiversity by altering species composition and disrupting the structure and function of ecosystems (e.g., Vitousek 1986, Greenberg et al. 1997). The planting of Central Asian wheatgrasses (*Agropyron* spp.) in western U.S. rangelands triggered outbreaks of generally innocuous native mirids or plant bugs (Lattin et al. 1994). Establishment of exotic grasses along highways can be detrimental to remnant native vegetation (Milberg and Lamont 1995). The use of African lovegrasses, including Boer lovegrass (*E. curvula* var. *conferta*), to revegetate southwestern U.S. rangelands appears to have adversely affected the native biota (Bock et al. 1986). But in the case of weeping lovegrass in the southeastern United States, its use along roadways might have enabled a scarce turtle to develop larger populations than is possible on native grasses with poorly developed crowns. A subspecies of the dotted skipper (*Hesperius attalus* Edwards) that is rare and local in New Jersey might be adapting to weeping lovegrass in the New Jersey Pine Barrens (Gochfeld 1998).

My observations of *O. clavicornis* populations at irregular intervals allow only tentative conclusions regarding its seasonality. Adults were seen in early December and in early and late March, but nymphs (second or third instar) were not observed until late April, indicating that adults overwinter, as is the case in *Amaurochrous cinctipes* (McPherson 1982). Nymphs of all stages (I–V) were present in mid-July. The presence of late-instar nymphs in early to mid-September suggests that populations are bivoltine rather than univoltine.

Because only three adults of *A. mississippiensis* were found on weeping love-

grass, its status on *E. curvula* is unknown. An *Allopodops* adult was found at Middendorf, S.C., with an adult of *O. clavicornis* and a podopine nymph of apparently the latter species. Further sampling of weeping lovegrass is needed to determine whether *A. mississippiensis* is beginning to adopt this African plant as a host.

Neither *A. mississippiensis* nor *O. clavicornis* might be considered rare under certain criteria (Gaston 1994), but too little is known about their ecological requirements and abundances to assess their rarity or vulnerability. As rarely collected species, they are potentially interesting to conservation biologists. Because both belong to monotypic genera, they are more relevant to the conservation of insect biodiversity than if they were members of species-rich genera.

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